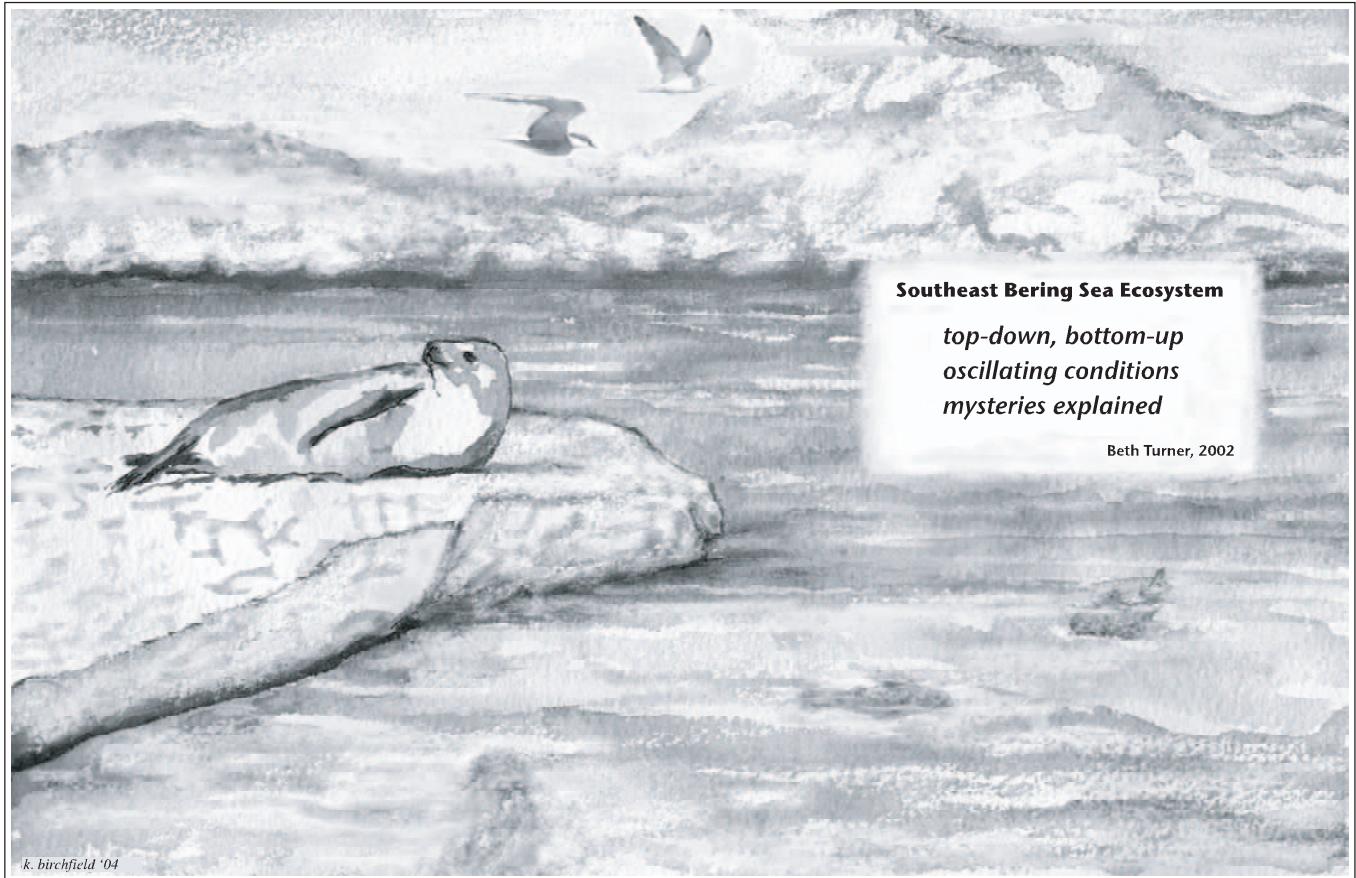


## Contents

|  |           |
|--|-----------|
| <b>Executive Summary . . . . .</b>   | <b>1</b>  |
| <b>Part 1—Introduction . . . . .</b>   | <b>9</b>  |
| <b>Part 2—Synthesis of Research: A Contemporary Understanding<br/>of the Southeast Bering Sea Ecosystem . . . . .</b>  | <b>11</b> |
| 2.1    Introduction . . . . .  | 11        |
| 2.1.1    Brief history and goals of recent research programs .   | 11        |
| 2.1.2    Structure of synthesis report . . . . .   | 12        |
| 2.1.3    Brief description of the Southeastern Bering Sea .  | 12        |
| 2.2    Climate and the Bering Sea Marine Ecosystem . . . . .   | 15        |
| 2.2.1    Climate indices . . . . .   | 15        |
| 2.2.2    Meteorological forcing . . . . .  | 20        |
| 2.3    Physical Components of the Eastern Bering Sea Ecosystem .   | 21        |
| 2.3.1    Sea Ice in the Eastern Bering Sea . . . . .   | 21        |
| 2.3.2    Biological importance of the timing of ice retreat .  | 26        |
| 2.3.3    Cold pool formation . . . . .   | 28        |
| 2.3.4    Biological impacts of water temperature . . . . .   | 29        |
| 2.3.5    On-shelf fluxes and nutrient replenishment . . . .  | 30        |
| 2.3.6    Stratification, mixing, and the vertical flux of nutrients  | 32        |
| 2.4    Biological Components of the Eastern Bering Sea Ecosystem   | 32        |
| 2.4.1    Primary production . . . . .  | 32        |
| 2.4.2    Coccolithophore bloom . . . . .   | 34        |
| 2.4.3    Zooplankton . . . . .   | 38        |
| 2.4.4    Fish . . . . .  | 44        |
| 2.4.5    Marine mammals and seabirds . . . . .   | 51        |
| 2.5    What Controls Recruitment of Walleye Pollock? . . . . .   | 62        |
| 2.6    Summary of Advances . . . . .   | 68        |
| 2.6.1    Marine climate . . . . .  | 68        |
| 2.6.2    Basin and slope waters . . . . .  | 68        |
| 2.6.3    Shelf waters . . . . .  | 68        |
| 2.6.4    Biological components of the ecosystem . . . . .  | 69        |
| 2.7    Areas of Research Requiring More Attention . . . . .  | 70        |
| 2.8    Acknowledgments . . . . .   | 72        |
| <b>Part 3—Forecasting Abundance of Walleye Pollock: Indices for<br/>Juvenile Abundance . . . . .</b>   | <b>73</b> |
| 3.1    Introduction . . . . .  | 73        |
| 3.2    Conceptual Framework for Development of Indices . . . .   | 76        |
| 3.2.1    A pollock-centric perspective of the southeastern Bering<br>Sea ecosystem . . . . .   | 76        |
| 3.2.2    A generic model of pathways of energy flow through<br>the ecosystem . . . . .   | 77        |
| 3.2.3    Other aspects of indices development . . . . .  | 79        |
| 3.3    Development of Environmental Indices . . . . .  | 80        |
| 3.3.1    Indices of stratification, potential supply of nutri-<br>ents to the upper mixed layer, and turbulence ex-<br>perienced by larval pollock (Carol Ladd and Phyllis<br>Stabeno) . . . . . | 80        |
| 3.3.2    An index related to wind turbulence and feeding suc-<br>cess (Bern Megrey and Nick Bond) . . . . .  | 83        |

|  |   |     |
|--|---|-----|
| 3.3.3  | Variations in net short wave radiation: Toward development of an index of when sufficient light exists for primary production (Jeff Napp and Nancy Kachel)  | 84  |
| 3.3.4  | Indices related to sea ice (Sigrid Salo and Phyllis Stabeno)  | 86  |
| 3.3.5  | Indices related to the cold pool and adjacent fronts (Peggy Sullivan)   | 89  |
| 3.3.6  | Pribilof age-0 pollock as an index of pollock year-class strength (Jim Ianelli)   | 90  |
| 3.3.7  | Model simulations   | 95  |
| 3.3.8  | A matrix for cataloging indices (Allen Macklin)   | 100 |
| 3.4  | Application of a Transport and Predation Index to Recruitment for Stock Assessment Purposes (Jim Ianelli)   | 103 |
| 3.4.1  | Background  | 103 |
| 3.4.2  | An application  | 105 |
| 3.4.3  | Discussion  | 106 |
| 3.5  | Changing Relationships between Climate and Biological Indices in the Eastern Bering Sea (Alan Springer)   | 112 |
| 3.5.1  | Introduction  | 112 |
| 3.5.2  | Observations  | 112 |
| 3.5.3  | Physical-physical relationships   | 113 |
| 3.5.4  | Physical-biological relationships   | 114 |
| 3.5.5  | Biological-biological relationships   | 117 |
| 3.5.6  | Discussion  | 120 |
| 3.6  | Summary   | 125 |
| 3.6.1  | Progress accomplished in the development of indices   | 125 |
| 3.6.2  | Further development of indices  | 127 |
| 3.6.3  | Concluding remarks  | 128 |
| <b>Part 4—Pribilof Islands: A Microcosm for the Southeast Bering Sea</b> |   |     |
| 4.1  | Overview of the Pribilof Island Ecosystem   | 129 |
| 4.2  | Working Group Products  | 130 |
| 4.2.1  | How large an area is the Pribilof region?   | 131 |
| 4.2.2  | How much transport is there to this area from major pollock spawning regions?   | 132 |
| 4.2.3  | How does the abundance of juvenile pollock near the Pribilof Islands compare with abundance along the Bering Sea Shelf?   | 133 |
| 4.2.4  | How does the abundance of age-0 pollock near the Pribilof Islands relate to diet, survival, and energetics of higher predators?   | 142 |
| 4.2.5  | How important is predation to pollock abundance near the Pribilof Islands?  | 146 |
| 4.3  | Comparison of abundance of juvenile pollock and zooplankton between the Pribilof Islands and other shelf areas in the eastern Bering Sea based on acoustic surveys in 1997, 1998, and 1999 (Andreas Winter and Kenneth Coyle) | 149 |
| 4.3.1  | Methods   | 149 |
| 4.3.2  | Results   | 154 |
| 4.3.3  | Discussion  | 155 |
| 4.4  | Summary and Conclusions   | 157 |
| <b>Part 5—SEBSCC Administration and Management</b>                       |   |     |
| 5.1  | Project Management Team   | 159 |
| 5.2  | Technical Advisory Committee  | 161 |

|      |  |     |
|------|--|-----|
| 5.3  | Research Council . . . . .                                 | 162 |
| 5.4  | Project Coordination and Communication . . . . .           | 162 |
| 5.5  | Data Management . . . . .                                  | 163 |
| 5.6  | Research Structure and Methodology . . . . .               | 164 |
| 5.7  | Resources . . . . .  | 165 |
| 5.8  | Leverage and Collaboration . . . . .                       | 165 |
| 5.9  | Research Components and Principal Investigators . . . . .  | 165 |
| 5.10 | Field Operations: SEBSCC Cruise Schedule . . . . .         | 170 |
|      | <b>Acknowledgments . . . . .</b>                           | 172 |
|      | <b>Part 6—References and SEBSCC Publications . . . . .</b> | 173 |



**Southeast Bering Sea Ecosystem**

*top-down, bottom-up  
oscillating conditions  
mysteries explained*

Beth Turner, 2002

*k. birchfield '04*